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Research Collaborations in an Academic Entrepreneurial Ecosystem: Insights from a Nigerian University

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Abstract

This study utilised a developed framework to identify the types of research collaborations within a university's entrepreneurial ecosystem and the perception of academics on intra- and inter-departmental collaborations. Using primary and secondary data from the University of Benin (UNIBEN), Nigeria, the secondary data included 151 published articles from the 3rd University of Benin Annual Research Conference, while the primary data consisted of responses from 90 randomly selected academics across 10 faculties. Among the 151 articles, 14 were authored individually, 77 by authors from the same department, 22 by authors from different departments within the same faculty, 7 by authors from different disciplines, 18 involved authors from different universities, 7 from university-industry collaborations, 4 from university-government collaborations, and 2 from international collaborations. The findings revealed a high level of intra- and inter-departmental collaborations but a low level of interdisciplinary and inter-institutional collaborations. Given the promising nature of the university's entrepreneurial ecosystem, it is recommended that scholars at UNIBEN increase their engagement in interdisciplinary and cross-institutional research collaborations to enhance the university's innovative capacity and its ranking in research and development.

Keywords: ***Research collaborations, academic entrepreneurial ecosystems, innovation***

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INTRODUCTION

Background of the problem

Entrepreneurship is about identifying opportunities, harnessing creativity, and driving innovation, usually through research, to create valuable products and services that can solve real-world problems and satisfy human needs and wants. According to Shane and Venkataraman (2000), entrepreneurship is the activity that involves the discovery, evaluation, and exploitation of opportunities to introduce new goods and services that previously did not exist. In the same vein, Kuratko and Hodgetts (2004) defined entrepreneurship as a dynamic process of vision, change, and innovation, which requires an application of energy and passion towards the creation and implementation of new ideas and creative solutions. In the face of the complexity and enormity of meeting global needs and challenges in various aspects of life, Van de Ven (1993), observed that individual entrepreneurs cannot command all the resources, institutions, markets, and business functions that are required to develop and commercialise their entrepreneurial ventures; hence the integration of the relevant resources into an efficient and effective system known as an entrepreneurial ecosystem.

Entrepreneurial ecosystems, according to Isenberg (2010), “are interactive networks of knowledge-based, creative, and business-oriented actors and factors that influence and complement each other to create innovative products and services.’ In other words, Stam (2015) posited that an entrepreneurial ecosystem is a set of interdependent actors and factors that lead to productive and innovative entrepreneurial activities in a particular region. Universities, being research and knowledge-based institutions, have been known to play significant roles in creating, enhancing, and driving entrepreneurial ecosystems within their environments (Van de Ven, 1993; Stam, 2015). According to Stem and Van de Ven (2021), entrepreneurship is a collective achievement that requires the participation of other entrepreneurs, policymakers, knowledge-based institutions, commercial institutions, and investors in both the public and private sectors to create an entrepreneurial ecosystem that facilitates creativity, innovation and business startups.

Academic Entrepreneurship Ecosystems (AEE)

An academic entrepreneurial ecosystem (AEE) is an entrepreneurship ecosystem that is centred within an academic institution and involves research and various entrepreneurial activities that affect its staff, students, and the surrounding community. This concept promotes collaboration among different faculties, departments, and units

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within the institution to integrate entrepreneurship. By doing so, it fosters innovation, encourages breakthroughs, drives economic growth, creates jobs, and generates a positive impact on society. Etzkowitz (2003) defines AEE as an interconnected web of relationships among universities, research institutions, industry partners, government agencies, and entrepreneurial support organizations that facilitate the creation, growth, and success of entrepreneurial ventures"(Etzkowitz, 2003, p. 296).

In 2007, Rothaermel et al. further expanded the definition as a complex system that comprises various actors, including universities, research centres, incubators, accelerators, and industry partners, which interact and collaborate to facilitate the creation and growth of entrepreneurial ventures (Rothaermel, Agung, & Jiang, 2007).

However, Wright, Piva, Mosey, and Lockett (2017), further defined AEE as a network of interconnected components, including universities, research institutions, industry partners, government agencies, and entrepreneurial support organizations, that work together to foster entrepreneurship, innovation, and economic development.

From the definitions above, the key elements of AEE are (1) to drive and support academic research that can bring about innovative and impactful findings that can be translated into entrepreneurial ventures or commercialisable products, (2) to provide resources, funding, and mentorship to academic researchers and entrepreneurs, (3) to facilitate industry-academia collaborations and knowledge transfer, and (4) to drive economic growth, job creation, and societal impact.

Furthermore, Etzkowitz (2003), Grimaldi, Kenney, Siegel, and Wright (2011), and Wright et al. (2017), revealed the key components of an Academic Entrepreneurial Ecosystem to include (1) Academic Institutions: Universities, research centers, and colleges that provide the foundation for research, innovation, and entrepreneurship, (2) Research and Innovation: The generation of new ideas, technologies, and products that can be translated into entrepreneurial ventures, (3) Entrepreneurial Support Organizations: Incubators, accelerators, coworking spaces, and other organizations that provide resources, funding, and mentorship to academic entrepreneurs, (4) Industry Partners: Companies that collaborate with academic institutions provide funding, and offer expertise to support the development of entrepreneurial ventures, (5) Government Agencies: Organizations that provide funding, policies, and regulations that support the development of AEEs, and (6) Mentorship and Networking: Opportunities for academic entrepreneurs to connect with experienced entrepreneurs, investors, and industry experts.

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While Nigeria has embraced the concept of entrepreneurship and made entrepreneurship development a compulsory item in the curricula of all federal universities, the desired outcomes of increased and improved research outputs, innovative products technological advancement, increased innovative startups are yet to fully materialise, thus creating a big gap between theory and practice of entrepreneurship in Nigerian tertiary institutions (Uwumbanwen & Obeki, 2019). This gap has been attributed to a lack of systematic integration of the relevant entrepreneurial resources to form a practical and functional entrepreneurial ecosystem, from which a high-impact collaborative researches, high-utility, high-technological and commercialisable innovative products can be created, as is the case with Stanford University's Silicon Valley, which is the global epicentre of technological advancement (Stam and Van de Ven, 2021).

Research Objectives

With the following research objectives, this study aimed to bridge the gap between the type and frequency of research collaborations and the innovative potential/products of a typical Nigerian university, and contribute to the existing knowledge on entrepreneurial ecosystems and research collaborations, and innovation:

1. To ascertain the characteristics (type and frequency) of research collaborations in the university's entrepreneurial ecosystem.
2. To determine the most prevalent research collaboration type within the university's entrepreneurial ecosystem
3. To determine the extent to which University of Benin academics perceive intra- and inter-departmental research collaborations as having significant innovation potential.

LITERATURE REVIEW

Conceptual framework

The general system theory by Ludwig von Bertalanffy (1968, cited in Froehlich,2019) is adopted as the conceptual framework of this study. The theory is based on the principle that a system works better when its parts are identified, understood and integrated in the context of relationships with each other and with other systems, rather than in isolation (Froehlich, 2019). An entrepreneurial ecosystem, like any other system, will be studied under the Systems theory, which asserts that every system has causal boundaries, is influenced by its context, defined by its structure, function and role, and

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expressed through its relations with other systems, and noted that a system is "more than the sum of its parts" by expressing synergy or emergent behavior (Bertalanffy (1968, cited in Froehlich, 2019).

Entrepreneurial Ecosystems

The entrepreneurial ecosystem as an idea emerged in the 1980s in the realisation of the complementary nature of entrepreneurship infrastructures and resources, thereby moving entrepreneurship away from its hitherto narrow individualistic model to a broader group or community-based model for a better outcome (Aldrich 1990; Nijkamp 2003). This idea is rapidly growing and producing huge results across the developed world, but this seems not to be the case in the developing world, including Nigeria.

Factors that shape entrepreneurial ecosystems include universities, industry clusters, and government policies. Universities contribute by fostering entrepreneurship education and technology transfer. Using the Silicon Valley innovation ecosystem where UC Berkeley, Stanford, and UC San Francisco universities helped in creating the highly successful Silicon Valley innovation business hub, universities, as a research hub, have been shown to play a crucial and unique role in entrepreneurship ecosystems (Spigel & Harrison, 2018). For maximum efficiency and functionality, Spigel and Harrison (2018) proposed that an entrepreneurial ecosystem should be located within a specific boundary where the actors and factors can be easily identified and coordinated.

Although work on entrepreneurial ecosystems is still developing, there are already empirical studies showing how university–related, or university-based entrepreneurial ecosystems have enabled high-growth entrepreneurship development and significant value creation at a campus, regional and national levels. For example, Spigel and Harrison's (2018) study of entrepreneurial ecosystems in Waterloo and Calgary, Canada, discovers that while ecosystems' structures and origins are different based on the product, service, or region they intend to serve, their success lies in their ability to create a cohesive social and economic system that supports the creation and growth of new ventures. Similarly, the study of such highly developed economic regions as Silicon Valley in Northern California, USA, which serves as a global centre for high technology and innovation and Route 128, a region in Massachusetts in Arizona USA that is notable for startups specialising in defence and high technology products, revealed that these regions leveraged their popularity and success on the research from the region's higher education system such as the Stanford University and Massachusetts' Institute of Technology, respectively (World Economic Forum, 2013). In the same vein, Stam (2015)

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explored the entrepreneurial successes in Phoenix, Arizona, and discovered a strong link between a strong entrepreneurial ecosystem, a strong entrepreneurial culture, supportive public policies, and strong institutional engagement.

Drawing from the thriving entrepreneurial ecosystems' stories of Stanford University and the Silicon Valley project in Arizona, USA (Stam & Van de Ven, 2018), it became evident that universities, being centres of knowledge, creativity, and infrastructure, have a lot to do with creating and promoting entrepreneurial ecosystems through research collaborations both internally and externally. Therefore, this study aims to get insight from a Nigerian university on the entrepreneurial ecosystem, collaborative research and innovation capacity.

Research Collaborations

Research is defined as the systematic investigation into the study of materials and sources to establish facts and reach new conclusions (Oxford Dictionary, 2024) and can be classified into basic academic research and professional research. While basic academic research seeks to expand knowledge, professional research aims to address real-world challenges (Boell, 2013; Creswell, 2014). Both play crucial roles in advancing our understanding and improving practices, and both types of research are carried out within an entrepreneurial ecosystem. However, this study sought to ascertain the most relevant type of research that will enhance the functionality of an entrepreneurial ecosystem, and which should attract the most collaboration and funding.

Al Masud (2024) defined collaborative research as a partnership between two or more parties who work together to achieve common goals. The COVID-19 pandemic, HIV/AIDS and other previous pandemics have made research collaborations more critical and imperative, especially in solving complex problems that evolve every day globally (Hays, 2005; Envuladu, Miner & Agho, 2022). Collaboration enables researchers from different backgrounds, such as industry and academia, to come together to address a problem, usually of multidimensional significance (Wuchty, et al., 2007).

According to Al Masud (2024), while research is the foundation for forming knowledge, collaboration is a strategy to deal with situations that seem challenging to solve individually and for developing solutions that can have a significant impact on society. For example, a business or government might partner with a university to conduct research on nuclear power, or cancer treatment. In this case, the business organization or government can provide the finances and resources for research while the university

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can provide the academic knowledge, theories, and expertise needed to analyse the data and draw meaningful conclusions that will enable an innovative solution to be obtained.

Therefore, this study aims to identify, categorise and discuss the different types of research in Nigerian universities to ascertain their innovation potential.

Types of Research Collaborations

Different scholars have identified different types of research collaborations. However, understanding the different types of collaborative research and how they can contribute to advancing knowledge in various fields will help to appreciate the value of collaborative research and its potential for creating positive, innovative changes in the world (Al Masud, 2024)

Al Masud (2024) identified two broad types of collaborative research, namely homogenous and heterogenous collaborations. Homogeneous research involves individuals or groups that share similar backgrounds or perspectives, while heterogeneous research involves individuals or groups with diverse backgrounds and perspectives. A collaborative research team is considered homogenous when the research team members are similar in terms of their backgrounds, expertise, and research interests. This type of collaborative research can be beneficial because team members may share similar perspectives and approaches to research, which can lead to more efficient and effective collaboration (Al Masud, 2024).

On the other hand, heterogeneous collaboration involves team members with diverse backgrounds, expertise, and research interests. While this type of collaboration can be more challenging, it can also lead to more innovative and creative research outcomes. Heterogeneous teams can bring different perspectives and ideas to the table, which can lead to new insights and approaches that might not have been possible with a more homogeneous team (Al Masud, 2024).

However, Springer Nature (2023), identified five types of research collaboration, which are (1) Collaboration within an academic institution: This type involves various configurations of faculty, staff, administrators, and students working together on research projects within the same institution. This setup allows for easy communication and face-to-face meetings, facilitating progress and adjustments. (2) Collaboration with other academic institutions: This type involves researchers from different institutions working together on a project, often with a primary investigator inviting junior researchers to collaborate. This collaboration promotes mutual benefits, such as sharing resources and expertise. (3) Collaboration with a government entity: This type involves policymakers and

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researchers working together to address common concerns or questions. Government agencies may provide funding or resources, while researchers offer expertise to inform policy decisions. (4) Collaboration with private industry: This type involves researchers partnering with private companies to develop new products, technologies, or services. This collaboration promotes innovation and can lead to groundbreaking discoveries. (5) Collaboration with international researchers: This type involves researchers from different countries working together on a project, often facilitated by global conferences, study abroad programs, or online platforms. International collaboration broadens cultural perspectives, increases the pool of research data, and fosters global solutions.

Research Collaboration and Entrepreneurial Ecosystem

Etzkowitz (2003), Bercovitz and Feldman (2006) observed that research collaboration in a university's entrepreneurial ecosystem with diverse faculties and resources can significantly impact innovation in several ways by combining expertise from various fields to promote innovation, facilitate the exchange of ideas, and resources, and instil an entrepreneurial mindset among researchers to think creatively and develop innovative solutions. In the same vein, Leydesdorff and Etzokowitz (1996), Siegel and Wright (2015) noted that research collaboration provides opportunities for researchers to connect with potential partners, investors, and mentors, expanding their professional networks and developing innovative products. They also submitted that interdisciplinary collaboration could facilitate the identification and solving of complex problems, leading to innovative solutions, and accelerate the development of prototypes, testing, and validation, reducing the time to market for innovative products and services.

Etzkowitz (2003), in his triple helix model of university–industry–government entrepreneurial ecosystem, noted the university's role to include the provision of infrastructure, resources, and facilities to support research collaboration and innovation, the development of programs, courses, and workshops to teach entrepreneurship skills, supporting researchers in commercializing their innovations, and promote collaborative academic research that could produce breakthroughs and contribute to knowledge in different areas of human endeavour.

Empirical Review

Several studies have been conducted on entrepreneurial ecosystems and research collaborations globally. However, for this study, whose focus is on entrepreneurial ecosystem and research collaborations in a Nigerian university, we have

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limited our empirical review to studies conducted in Nigeria by Nigerian academics, and four of such studies were reviewed as follows:

Oyelaran-Oyeyinka and Adebowale (2012) conducted a study on university-industry collaboration as a determinant of innovation in Nigeria. Using notable research institutes and selected universities in Nigeria, they examined the types, intensity, and impact of collaboration and learning between universities and research institutes. The findings, which were arrived at through descriptive statistics and Probit regression analysis, revealed that the size of the research institute, its available infrastructure and human capability through the availability of grants and knowledge base, influence the types and intensity of collaboration and the resulting level of innovation. The study encourages university-industry research collaboration.

Ogunsola (2011) investigated the impact of research collaboration on academic productivity in Nigerian universities. Using a survey of 150 academics from five Nigerian universities, the results showed that research collaboration had a significant positive impact on academic productivity, measured by the number of publications, citations, and research grants. The study also found that the frequency and quality of research collaboration were significant predictors of academic productivity.

Adelowo, Ilevbare, and Morufu (2022) researched collaboration, networking and research productivity in Nigeria's research institutes. The study utilised a cross-sectional survey with data collected from a total of 1611 senior researchers, scientists and engineers in seventeen research agencies/institutes in Nigeria. The results showed that internal collaborations among researchers and scientists were high, and the purpose of collaboration included research engagement, grantsmanship writing and journal publications. The findings also revealed that most researchers engaged in external collaboration, particularly with other research institutes, Universities and Polytechnics, with a significantly positive effect of collaboration on research productivity.

Obeki and Oshio (2025) developed a categorisation framework for research collaborations in Nigerian universities and used the framework to assess the innovative potential of the universities. In the study, a total of 1946 articles that were published in 139 Nigerian journals from the 274 universities in Nigeria (Statista, 2024) were assessed, categorized into 8 groups of research collaborations, labelled C1 to C8, as shown below:

C1 Collaboration: Single authorship (No collaboration. Research carried out by a single author in a department)

C2 Collaboration: Intra-departmental Collaboration (Research collaboration between two or more authors in the same department).

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C3 Collaboration: Inter-departmental collaboration (Research collaboration between two or more authors from different departments within the same faculty)

C4 Collaboration: Inter-faculty/inter-disciplinary collaboration (Research collaboration between two or more authors from different faculties/disciplines, e.g., Law and Medicine)

C5 Collaboration: Inter-university collaboration (Research Collaboration between authors from two or more different universities or tertiary institutions)

C6 Collaboration: University-industry collaboration (Research collaboration between a university/tertiary institution and a private/public company)

C7 Collaboration: University-government collaboration (Research collaboration between a university and government agency/research institute).

C8 Collaboration: International collaborations: Research collaboration between scholars/organisations from Nigerian universities and foreign universities.

Research Assumptions

The above categorisation (C1 – C8) was based on the following assumptions on research collaboration and innovative potential from the empirical evidence provided by Klein (1990), Etzkowitz (2003), Cummings and Kiesler (2005), Wuchty, Jones and Uzzi (2007), Fleming, Isenberg (2010), Ogunsola (2011), Stam (2015), and Al Masud (2024):

i. A higher frequency of C1 and C2 collaborations often results in more localised research outcomes, limiting the prospects of obtaining resources necessary for innovation and impactful advancements.
ii. Increased interdisciplinary (C4) collaborations lead to greater access to cross-disciplinary knowledge and resources, fostering impactful results and driving innovation.
iii. Collaborations at the inter-university (C5), university-industry (C6), university-government (C7), and international levels (C8) enhance the potential for securing resources, gaining interdisciplinary insights, and achieving economic, technological, and innovative growth for the involved institutions and nations.
iv. Greater engagement in C4 through C8 collaborations leads to more impactful research outputs, higher publication rates in renowned journals, and improved university rankings in research, development, and innovation.

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This study relied on the C1-C8 groupings to categorise research collaboration in the University of Benin entrepreneurial ecosystem, used the research assumptions to answer the following research questions:

1 What are the characteristics of research collaborations in the university entrepreneurial ecosystem, and how can they be categorized into the C1–C8 groups?
2 Which research collaboration group (C1–C8) is the most prevalent within the university entrepreneurial ecosystem?
3 Do University of Benin academics perceive intra- and inter-departmental research collaborations as having significant innovation potential?

Hypotheses

The following two null hypotheses were formulated and tested on the primary data concerning the research questions in the administered questionnaire:

Ho1: The level of interdisciplinary research collaboration within the university's entrepreneurial ecosystem is not significant

Ho2: University of Benin academics do not perceive intra- and inter-departmental research collaborations as having significant innovation potential.

RESEARCH METHOD

The Research Station: The University of Benin, Nigeria

The University of Benin, Benin City, Nigeria, where the two authors work as academic staff, was chosen as the research station for its entrepreneurial ecosystem. The University of Benin was founded on Saturday, 23rd November 1970 to be a model of higher learning in the area of academic and research excellence. Today, the University has produced over 350,000 graduates and boasts of 17 faculties, schools, and institutes with 130 academic disciplines, ranging from Agriculture, Engineering, Medicine Science, Arts, and Management Science to Education (UNIBEN Convocation Brochure, 2023). The University is surrounded by other universities, colleges of education, polytechnics and industrial organisations that form a veritable structure for inter- and multi-disciplinary research collaborations. In addition, the University of Benin is a prominent beneficiary of Nigeria's Tertiary Education Trust Fund (Tetfund) grants for research (both Institution-based and national research funds) (TETFUND, 2024).

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Population

The population consisted of both primary and secondary data. The secondary data population consisted of all published research articles in the Book of Proceedings of the University of Benin Annual Research Conference, while the primary data population consisted of all academic staff at the University of Benin. The University of Benin Annual Research Conference promotes and showcases the research efforts and outputs of the university's academics and allows all academic staff of the University to participate in the conference.

Sample size

The University of Benin Annual Research Day (UBARD) Conference is an event that allows all academic staff of the University to participate and publish their research findings. We randomly selected one out of the three books on proceedings of the UBARD conferences, and we picked the 3rd UBARD Conference proceedings, held in 2018 for this study. The book contained 151 published articles by UNIBEN academics, which formed the sample size for this study. However, for the primary data, a random sampling of 90 academic staff in randomly selected 10 faculties of the University was used.

The Research Instrument

This study used both primary and secondary data. The secondary data, or documentary research relied on the articles published in the Book of Proceedings of the 3rd edition of the University of Benin Annual Research Day Conference, while primary data were obtained through a structured questionnaire from 90 randomly selected lecturers from 10 faculties in the University (see table 1 below).

In other to complement the secondary data (published research from the University of Benin), a total of 90 academic staff from ten (10) faculties were randomly selected for a survey with the administration of a structured questionnaire.

Table 1: Sampled academic staff in University of Benin

	No of sampled academic staff
Faculty of Arts/Social Sciences	15
Faculty of Physical /Life Sciences	15
Faculty of Management Sciences	15
Faculty of Engineering	15

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Faculty of Agric/Pharmacy	15
Faculty of Law/Education	15
Total	**90**

Source: Authors' Fieldwork, 2025

Table 1 above reveals that in addition to the secondary data from published articles, primary data was also obtained from 90 academic staff who were randomly selected from 10 faculties to complete the following questionnaire:

The Research Collaboration Questionnaire

Dear Respondent,

We are conducting a study to understand the types of research collaborations within our academic community. Please indicate the number of your publications that fall into each of the following categories:

1. Single Authorship (C1): Research carried out by a single author within a department.
   Number of publications: _____
2. Intra-Departmental Collaboration (C2): Research collaboration between two or more authors within the same department.
   Number of publications: _____
3. Inter-Departmental Collaboration (C3): Research collaboration between two or more authors from different departments within the same faculty.
   Number of publications: _____
4. Interdisciplinary/Inter-Faculty Collaboration (C4): Research collaboration between two or more authors from different faculties or disciplines.
   Number of publications: _____
5. Inter-University Collaboration (C5): Research collaboration between authors from different universities or tertiary institutions.
   Number of publications: _____
6. University-Industry Collaboration (C6): Research collaboration between a university/tertiary institution and a private/public company.
   Number of publications: _____
7. University-Government Collaboration (C7): Research collaboration between a university and a government agency or research institute.
   Number of publications: _____

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8. International Collaboration (C8): Research collaboration between scholars or organizations from Nigerian universities and foreign universities.

   Number of publications: _____

9. As a researcher, please indicate your level of agreement with the statement below:

   To what extent do you agree that intra- and inter-departmental research collaborations have significant potential for innovation?

Strongly Agree (SA)	Agree (A)	Undecided (UD)	Disagree (D)	Strongly Disagree (SD)

RESULTS

Types and Frequency of Collaborations

Using the categorization framework created by Obeki and Oshio (2025), the type and frequency of research collaborations in the 151 articles assessed for this study are presented in Table 2 below:

Table 2: Type and Frequency of Collaborations (secondary data)

Type of Research Collaboration	Frequency	Percentage
C1(Single authorship)	14	9.3
C2 (Intra-Departmental)	77	51.0
C3 (Inter-departmental)	22	14.6
C4 (Interdisciplinary/faculty)	7	4.6
C5 (Inter-University)	18	12.0
C6 (University-Industry)	7	4.6
C7 (University-Government)	4	2.6
C8 (International)	2	1.3
TOTAL	**151**	**100 %**

Source: Authors' Fieldwork (2025)

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Table 2 above shows the types and frequency of research collaborations in sampled published articles at the University of Benin. The Table shows a preponderance of C2 (intra departmental) and C3 (inter-departmental) research collaborations.

Table 3: Interfaculty collaboration index at the University of Benin (empirical data)

	Faculties					
	Arts/Social Sciences	**Phy/Life Scs**	**Law/Edu**	**Engineering**	**Agric/Pharmacy**	**Mgt Sci**
C1(Single authorship)	01 (6.7%)	02 (13.3%)	02 (13.3%)	-	01 (6/7%)	02 (13.3%)
C2 (Intra-departmental)	04 (26.7%)	04(26.7%)	05 (33.3%)	04 (26.7%)	05(33.3%)	04 (26.7%)
C3 (Inter-departmental)	02 (13.3%)	03 (20%)	02 (13.3%)	03 (20%)	03(20%)	02 (13.3%)
C4(Inter-disciplinary/faculty)	03 (20%)	01 (6.7%)	01 (6.7%)	01 (6.7%)	02(13.3%)	02 (13/3%)
C5 (Inter-University)	02 (13.3%)	02(13.3%)	02 (13.3%)	02 (13.3%	01(6.7%)	02 (13.3%)
C6 (University-Industry)	-	01(6.7%)	-	02 (13.3%)	-	01 (6/7%)
C7 (University-Government)	-	01(6.7%)	02(13.3%)	01 (6.7%)	01(6.7%)	-
C8 (International)	03 (20%)	01(6.7%)	01(6.7%)	02(13.3%)	02(13.3%)	02(13.3%)
Frequency (total)	15	15	15	15	15	15

Difference in collaboration between were not significant $p>0.05$, $d = 16.5$ using single ANOVA statistics at 0.05 level of confidence (Excel Analytical tool).

Table 4: Collaborative Research holds potential for innovation in University of Benin

	Faculty of Arts/Social Scs	Faculty of Phy/Life Sciences	Faculty of Management Sciences	Faculty of Engineering	Faculty of Agric/Pharm	Faculty of Law/Education
SA	03 (20%)	04(26.7%)	02(13.3%)	04(26.7%)	06(40%)	04(26.7%)
A	05(33.3%)	06(40%)	07(46.7%)	03(20%)	03(20%)	06(40%)
UD	01 (6.7%)	-	01(6.7%)	02(13.3%)	-	02(13.3%)
D	04(26.7%)	03(20%)	04(26.7%)	04(26.7%)	04(26.7%)	03(20%)
SD	02(13.3%)	02(13.3%)	01(6.7%)	02(13.3%)	02(13.3%)	-
Freq (Total)	15	15	15	15	15	15

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Collaborative research between faculties does not significantly affect innovation p>0.05, d = 13.5 using single ANOVA statistics at 0.05 level of confidence (Excel Analytical tool).

DISCUSSION

Table 1 categorises research collaborations within the University of Benin's entrepreneurial ecosystem into eight types (C1- C8), highlighting their frequency and percentage as shown below:

C1 Collaboration: Single Authorship (No Collaboration) - Independent research within a department. Frequency: 14 (9.3%).

C2 Collaboration: Intra-departmental collaboration - Research among authors from the same department. Frequency: 77 (51.0%).

C3 Collaboration: Inter-departmental collaboration - Collaboration between departments within the same faculty. Frequency: 22 (14.6%).

C4 Collaboration: Interdisciplinary/Inter-Faculty Collaboration - Cross-faculty or cross-discipline research. Frequency: 7 (4.6%).

C5 Collaboration: Inter-University Collaboration - Research between authors from different universities. Frequency: 18 (12.0%).

C6 Collaboration: University-Industry Collaboration - Partnerships with private organisations. Frequency: 7 (4.6%).

C7 Collaboration: University-Government Collaboration - Collaborative research with government agencies. Frequency: 4 (2.6%).

C8 Collaboration: International Collaboration - Research with entities in different countries. Frequency: 2 (1.3%)

CONCLUSION

Research Questions

Research Question 1: Characteristics and Categorisation of Research Collaborations:

The research collaborations are categorized into eight types (C1-C8), ranging from single authorship (C1) to international collaborations (C8). Each type represents a different level of collaboration, from intra-departmental to interdisciplinary and international partnerships.

Research Question 2: Most Prevalent Research Collaboration Group:

According to Table 1, the most prevalent research collaboration group is C2 (Intra-Departmental Collaboration), with a frequency of 77 and a percentage of 51.0%.

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Research Question 3: Do University of Benin academics perceive intra- and inter-departmental research collaborations as having significant innovation potential? Curiously, a majority of UNIBEN academic did not perceive intra- and inter-departmental research collaborations as having significant innovation potential.

Relating the findings to the adopted research assumptions above, the higher frequencies of C1 and C2 collaborations often result in more localized research outcomes, limiting the prospects for obtaining resources necessary for innovation and impactful advancements. Therefore, while C2 is the most prevalent, its innovative potential may be limited compared to other types of collaborations like C4 (Interdisciplinary) and C5-C8 (Inter-University, University-Industry, University-Government, and International) which are associated with greater access to resources and interdisciplinary insights. This is in consonant with the perception of a majority of UNIBEN academics that intra- and inter-departmental research collaborations do not have significant innovation potential.

Research Hypotheses:

The hypotheses were tested using the empirical data from the 90 randomly selected academic staff in Table 1 above and the regression analysis generated in Tables 2 and 3 above.

Hypothesis One: The level of interdisciplinary research collaboration within the university's entrepreneurial ecosystem is not significant:

From Table 2 above, the difference in collaboration types between the faculties was not significant at $p>0.05$, $d = 16.5$ using single ANOVA statistics at a 0.05 level of confidence. **Decision**: Therefore, the null hypothesis is not rejected or failed to be rejected. Hence, the level of interdisciplinary research collaboration within the university's entrepreneurial ecosystem is not significant.

This statistical result is in support of the secondary data of 151 collaborations, with the significant number being intra-departmental (C2) and inter-departmental (C3) collaborations only.

Hypothesis Two: University of Benin academics do not perceive intra- and inter-departmental research collaborations as having significant innovation potential.

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Table 3 above shows that collaborative research between faculties does not significantly affect innovation at p>0.05, d = 13.5 using single ANOVA statistics at a 0.05 level of confidence.

Decision: Therefore, the null hypothesis is not rejected or failed to be rejected. Hence, the University of Benin academics do not perceive intra- and inter-departmental research collaborations as having significant innovation potential. Hence, the most prevalent research collaboration type in the university's entrepreneurial ecosystem (C1 and C2), does not have high innovation potential.

This statistical result also supports the secondary data in which the most prevalent collaboration type is C2, which, according to the underlying assumptions, has limited innovative potential. This supports the hypothesis that the most prevalent research collaboration does not have a high innovation potential.

From the foregoing, the study reveals a preponderance of C1 and C2 (Single authorship and Intra-Departmental Collaborations) with limited innovative potential in the University, which is partly due to the need to publish to meet the criteria for promotion. However, this has several implications for the university's entrepreneurial ecosystem as follows: (1) Higher frequencies of C1 and C2 collaborations often result in more localized research outcomes. This means that the research conducted within the same department may not have the broader impact or reach that interdisciplinary or international collaborations might achieve, (2) the limited innovative potential in C2 collaborations restricts the prospects for obtaining resources necessary for innovation and impactful advancements. This can hinder the ability to secure funding, access cutting-edge technology, and attract top-tier talent, (3) Intra-departmental collaborations may lack the interdisciplinary insights that come from collaborations involving different faculties or disciplines. This can limit the scope of research and the ability to address complex, multifaceted problems.

On the other hand, greater engagement in interdisciplinary (C4) and inter-university (C5- C8) collaborations leads to more impactful research outputs, higher publication rates in renowned journals, and improved university rankings in research, development, and innovation. Indeed, collaborations at the inter-university (C5), university-industry (C6), university-government (C7), and international levels (C8) have been shown to enhance the potential for achieving economic, technological, and innovative growth for the involved institutions and nations, and should be encouraged and duly supported in the University.

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Recommendations

Entrepreneurial ecosystems fired by interdisciplinary and cross-institutional collaborations are the basic ingredients in the 21st-century innovative products and services, which every university, including the University of Benin, should imbibe. Therefore, to enhance the quality, relevance, and impact of research in the University of Benin, and by implication, any other university in Nigeria, we strongly recommend that university academics prioritise interdisciplinary research collaborations over single authorship and intra-departmental research. This approach will facilitate the integration of diverse perspectives, methods, and expertise, leading to more comprehensive and innovative solutions to complex problems.

Indeed, the rationale for interdisciplinary research collaboration becomes more compelling given the complexity of real-world problems such as climate change, pandemics, economic inequality, new strains of disease-causing bacteria and viruses, etc., which require broad perspectives, specialized technology and methodological expertise to deal with. Collaborative research across disciplines can foster Innovative solutions through the integration of diverse perspectives and methods, enhance research quality through rigorous peer review and critique, increase research impact through the development of practical, applicable solutions, and improve research funding opportunities through the demonstration of interdisciplinary collaboration.

To achieve the benefits of collaborative research in the university's entrepreneurial ecosystem, we recommend that the University of Benin do the following:

1. Incentivize researchers to collaborate across departments and disciplines by providing resources and support for joint research projects and giving articles arising from collaborative research more points than those from single authorships.
2. Establish programs that bring together researchers from diverse disciplines to tackle complex problems, providing a framework for collaboration and knowledge sharing
3. Offer training and development programs that help researchers develop the skills and competencies necessary for effective interdisciplinary collaboration.
4. Develop funding schemes that prioritise interdisciplinary research collaborations, providing financial support for joint research projects.
5. By prioritising interdisciplinary research collaborations, the University of Benin can develop more innovative, comprehensive, and impactful solutions to

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complex problems, ultimately enhancing the quality and relevance of its rich entrepreneurial ecosystem.

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